FORWARD MINING

Sound Reduction 793C XQ Mining Truck

Jim Humphrey– Global Mining

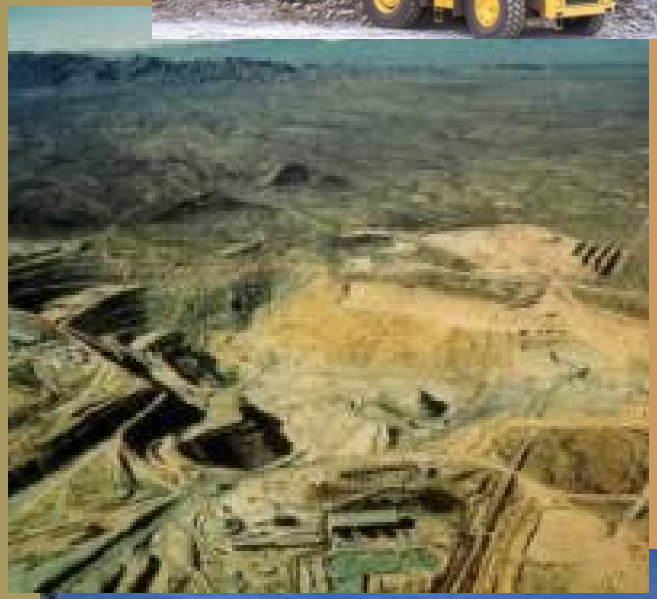
793C SOUND REDUCTION

Why/Purpose:

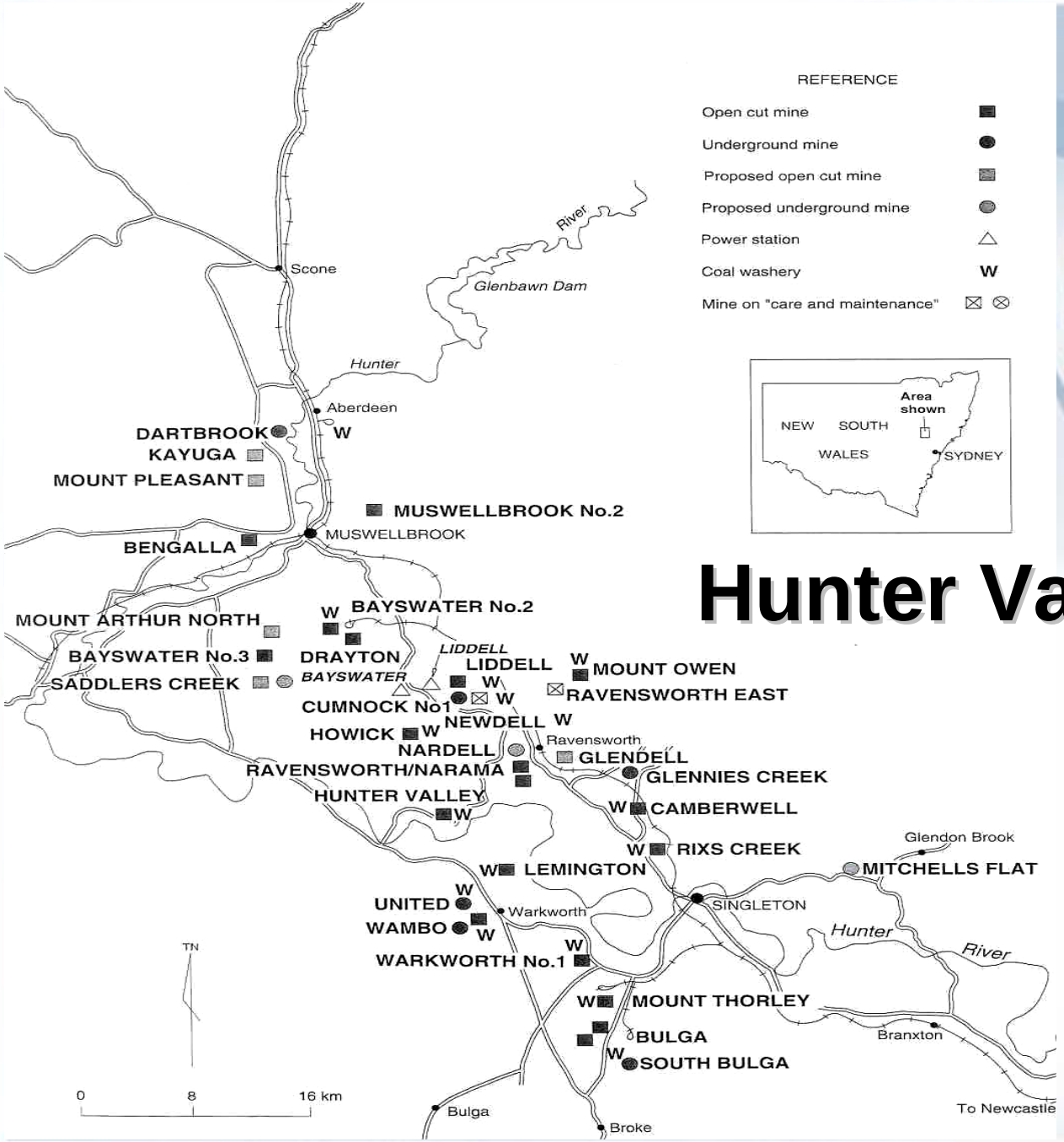
- **Comply with NSW Industrial Noise Policy**

- **Meet Market Demands →Preserve the Quality of Life**

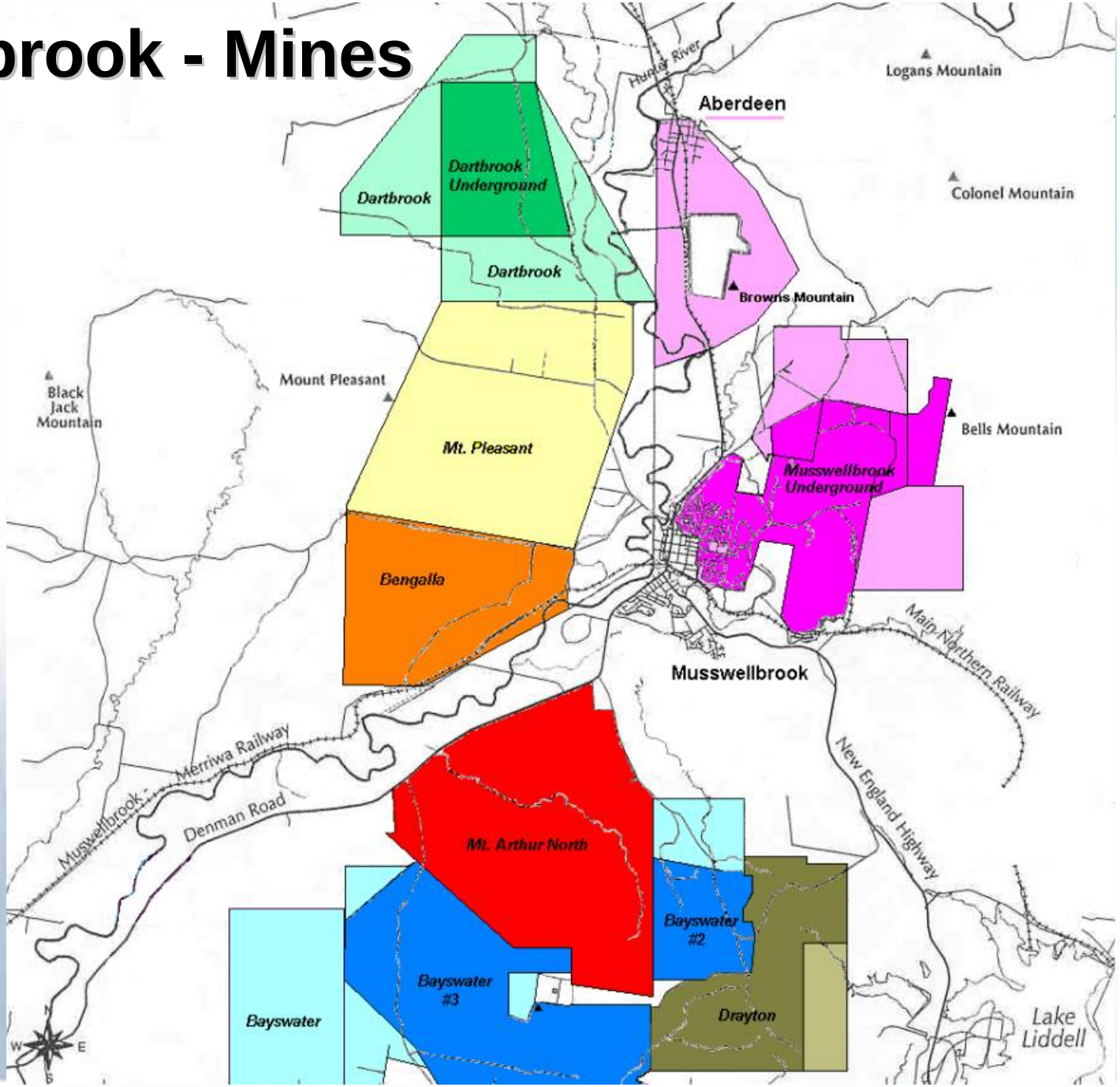
- **Sound Level goals - ISO6393,ISO6395**
  - –110 dB(A) STATIC
  - –113 dB(A) DYNAMIC



Hunter Valley - Mines



Musswellbrook - Mines



NSW Industrial Noise Policy

Industrial activity to be balanced w/ the desire for quiet in the community

Objectives:

•Establish noise criteria – protect community & preserve amenity for specific land uses

•Criteria as basis for deriving specific noise levels

•Promote uniform methods to est. & measure noise impacts

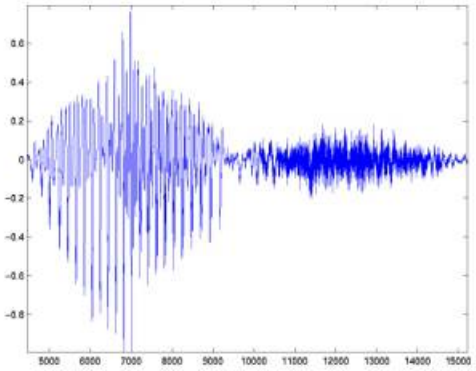
E.P.A (Environment Protection Authority) – Published

NSW Industrial Noise Policy

Responsibilities – Applying Policy:

•Land-use planner: likely impacts at early stage of planning process

•Land-use manager: provide adequate regulation of noise



Recommended Noise Levels

Type of Receiver	Area	Time of Day	Recommended Noise Level dB(A)	
			Acceptable	Recommended Max
Residence	Rural	Day	50	55
		Evening	45	50
		Night	40	45
	Suburban	Day	55	60
		Evening	45	50
		Night	40	45
	Urban	Day	60	65
		Evening	50	55
		Night	45	50
School		All	35	40
Hospital-Internal		All	35	40
Golf Course		All	55	60
Commercial		All	65	70
Industrial		All	70	75

License/Consent

Process:

Hire Consultant

Sound Model -

Determine Noise levels

Measure Source Noise

Environmental Impact Statement -

Submit EIS

Consider Mitigation Options

Monitor

793C XQ - GOAL

STATIC (SPECTATOR SOUND)

121 dB(A) → 110 dB(A)

Design Concept

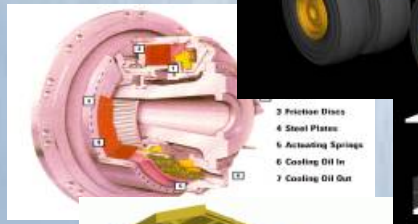
Holistic Approach

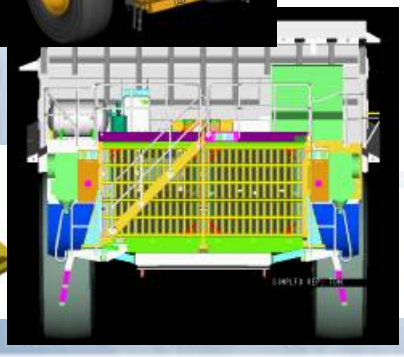
Customer Requirements

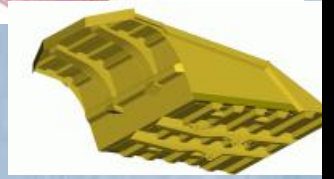
Cost

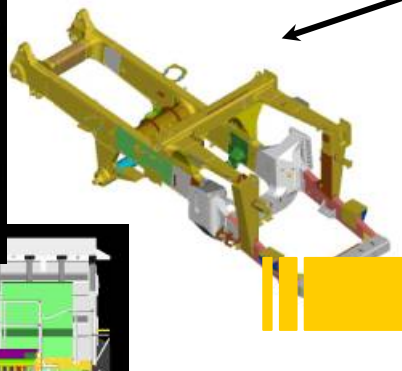
Sound Reduction

Productivity









Environment

Structural integrity
Durability
Reliability
Accessibility
Serviceability
Performance

Sound Pad for ISO Testing

Meets ISO 6393/6395

6 microphones on hemisphere

16m radius

Computer automated for production tests

Dynamic Sound Testing

Test Criteria

Road with a gradient of 10%

Normal operating speed conditions

Uphill fully loaded

Downhill empty

Sound 101:

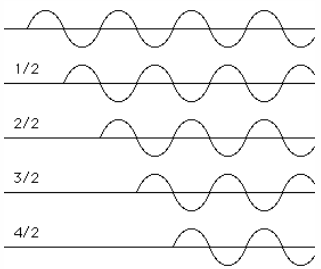
Treatment Options

Source Reduction

- Reduction of prime source
- Removal of source, replacement or just “turning it down

Cancellation

- Analyze wave form of sound & invert it



Directionality

- Divert sound away from spectator

Sound 101:

Treatment Options

Absorption

–Convert sound energy to motion & heat – reflects only a portion of the sound

Barriers

–Material that reflects a majority of the sound away from spectator

Damping

–Material is used to reduce sound generated by motion of an object

Sound 101:

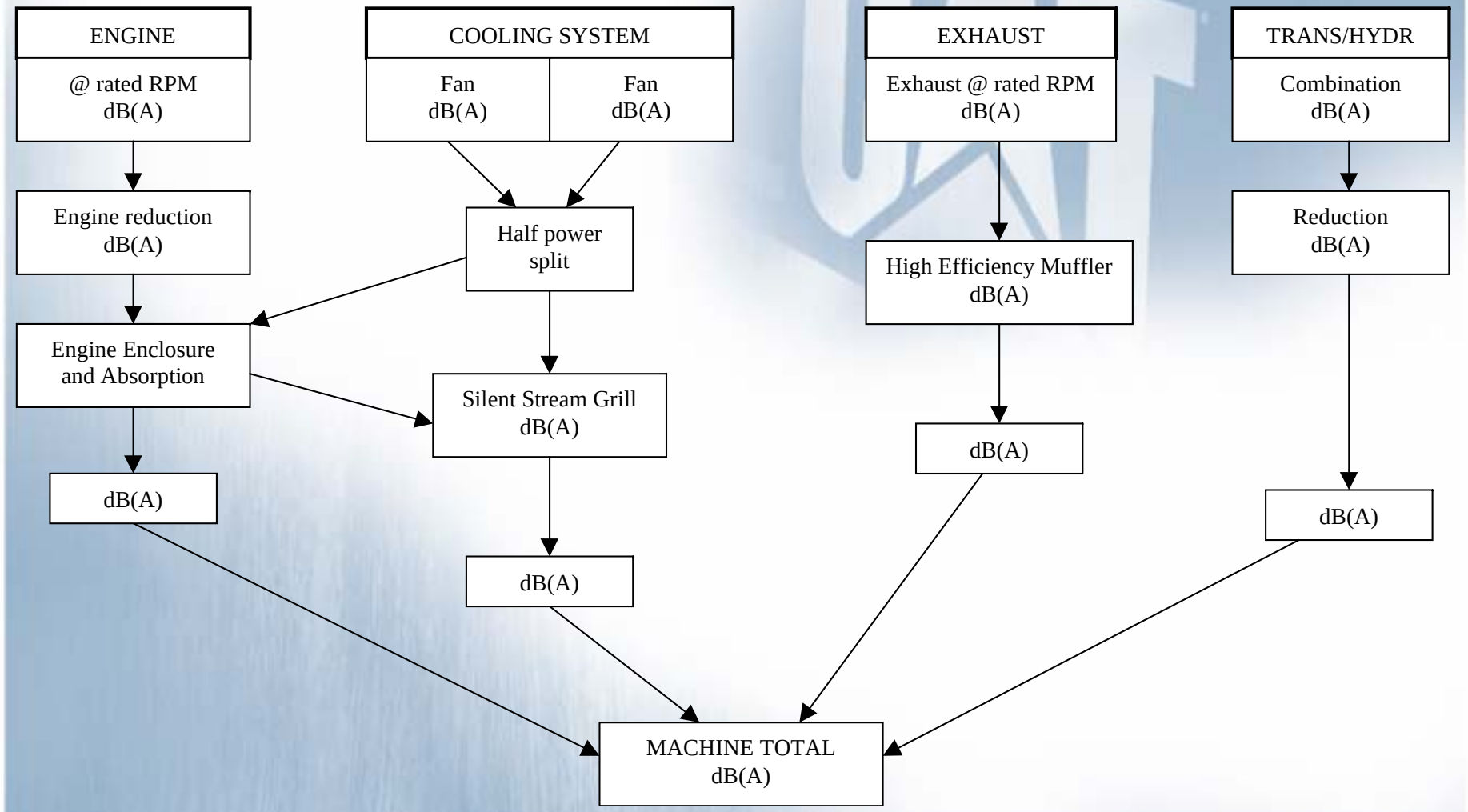
Treatment Options

- Most Practical → Source Reduction
  - Damping
  - Absorption
  - Barriers

- Cancellation not feasible because of frequency ranges

- Directionality provided inconsistent results → variation In ground conditions

SONIC+ Modeling



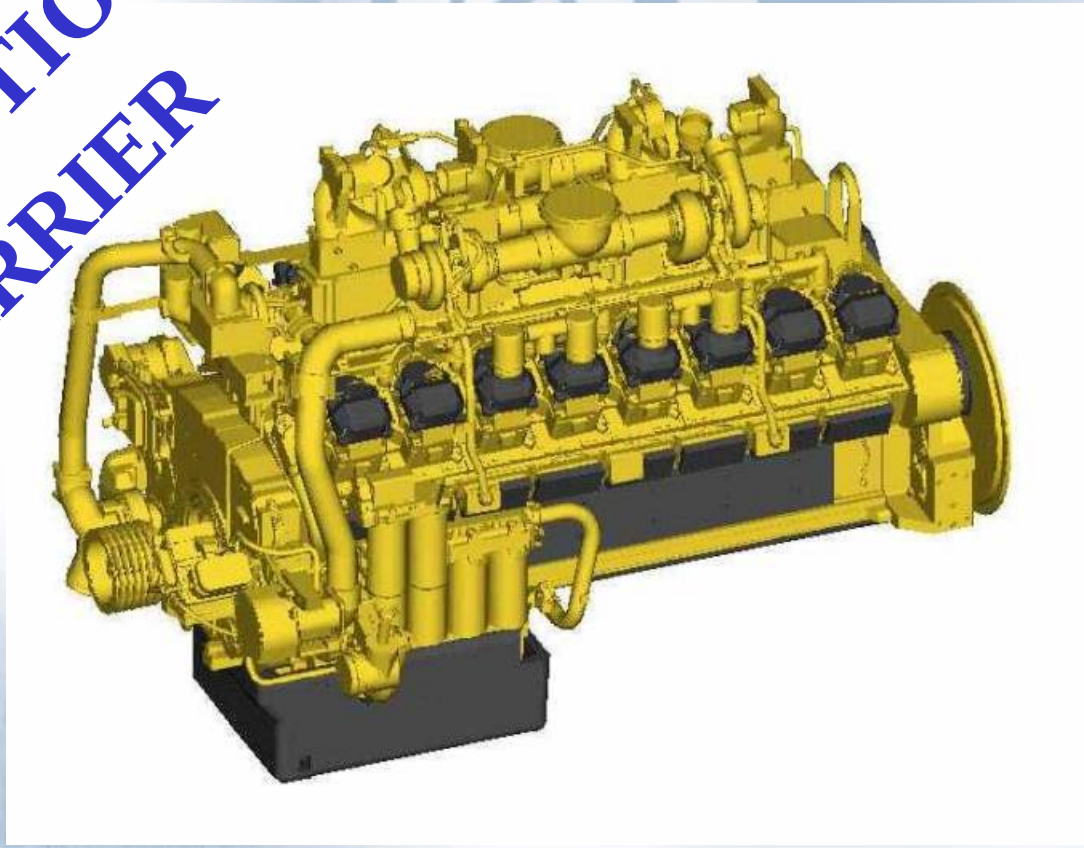
793C XQ Approach

- Engine
- Fan
- Exhaust
- Transmission / Drivetrain
- Hydraulics

793C XQ Engine Treatment

- Valve covers
- Block covers
- Oil pan covers
- Camshaft covers

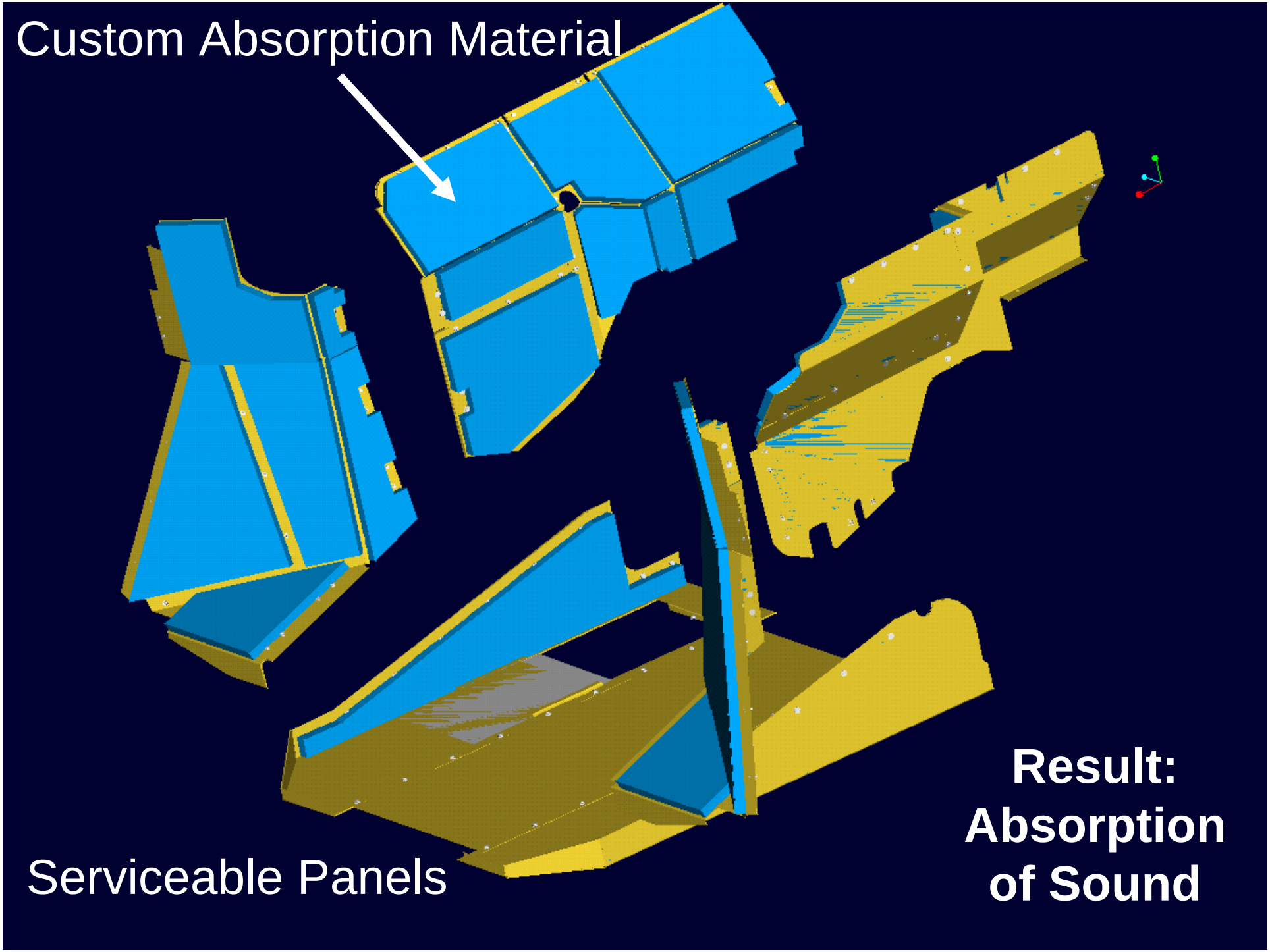
ABSORPTION BARRIER



Engine Sound Evaluation

- Engine RPM's can be controlled
  Max Torque at lower RPM
- Top Gear Engine Reduction
- Quiet Reverse
- Body Up Sound Reduction
- Location Specific Reduction

SOURCE REDUCTION


Custom Absorption Material
Serviceable Panels
Result:
Absorption
of Sound

793C XQ Approach

- Engine
- Fan
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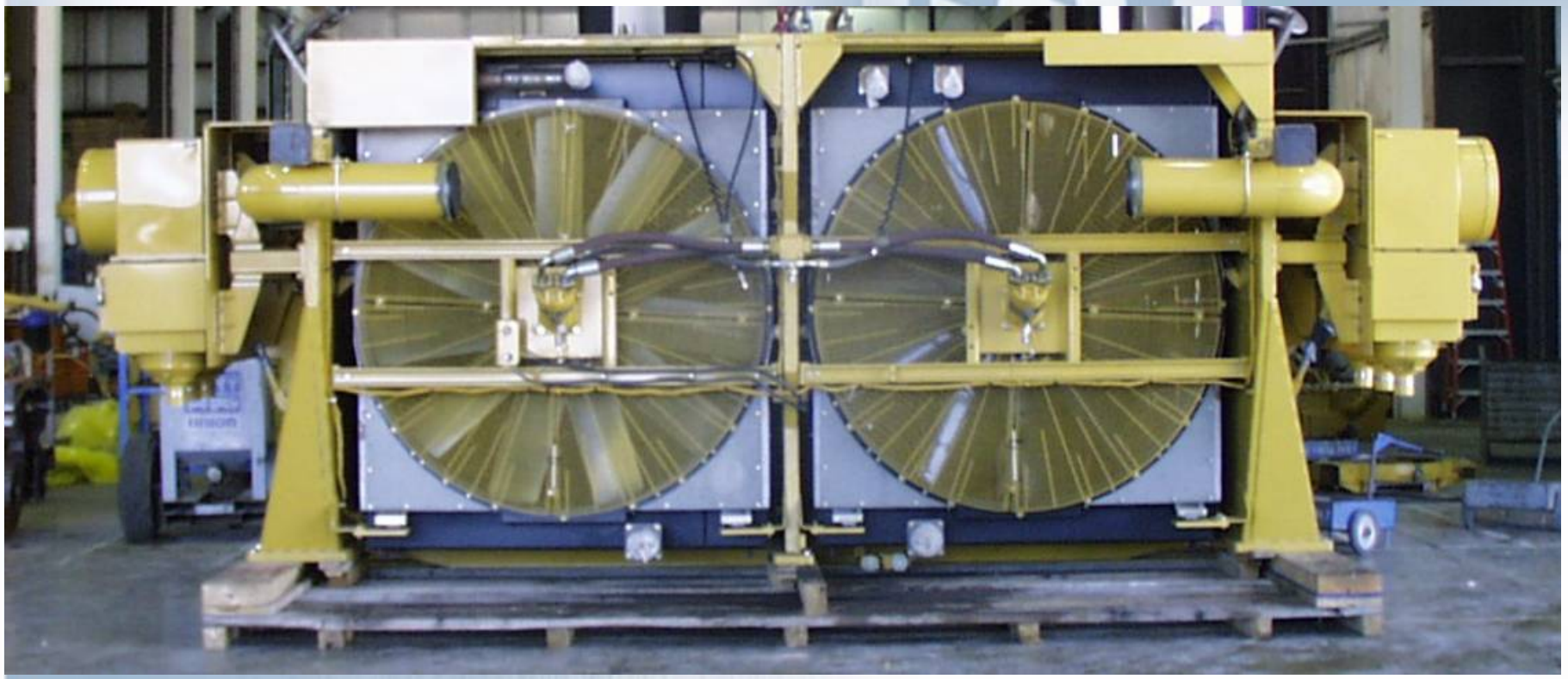
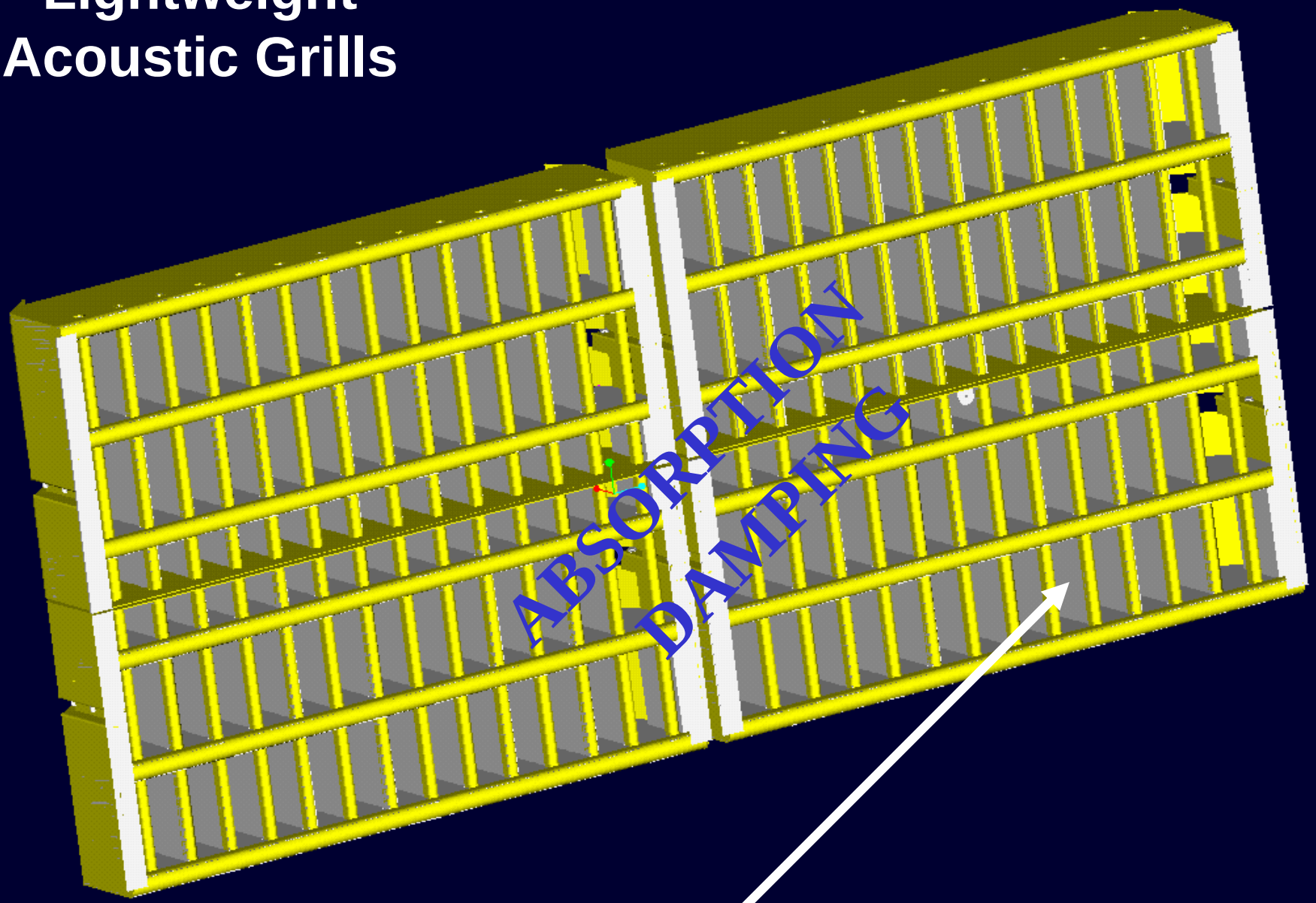
- Transmission / Drivetrain
- Hydraulics

793C XQ Dual Radiator



Lightweight Acoustic Grills




CATERPILLAR
CATERPILLAR

793C Sound Reduction

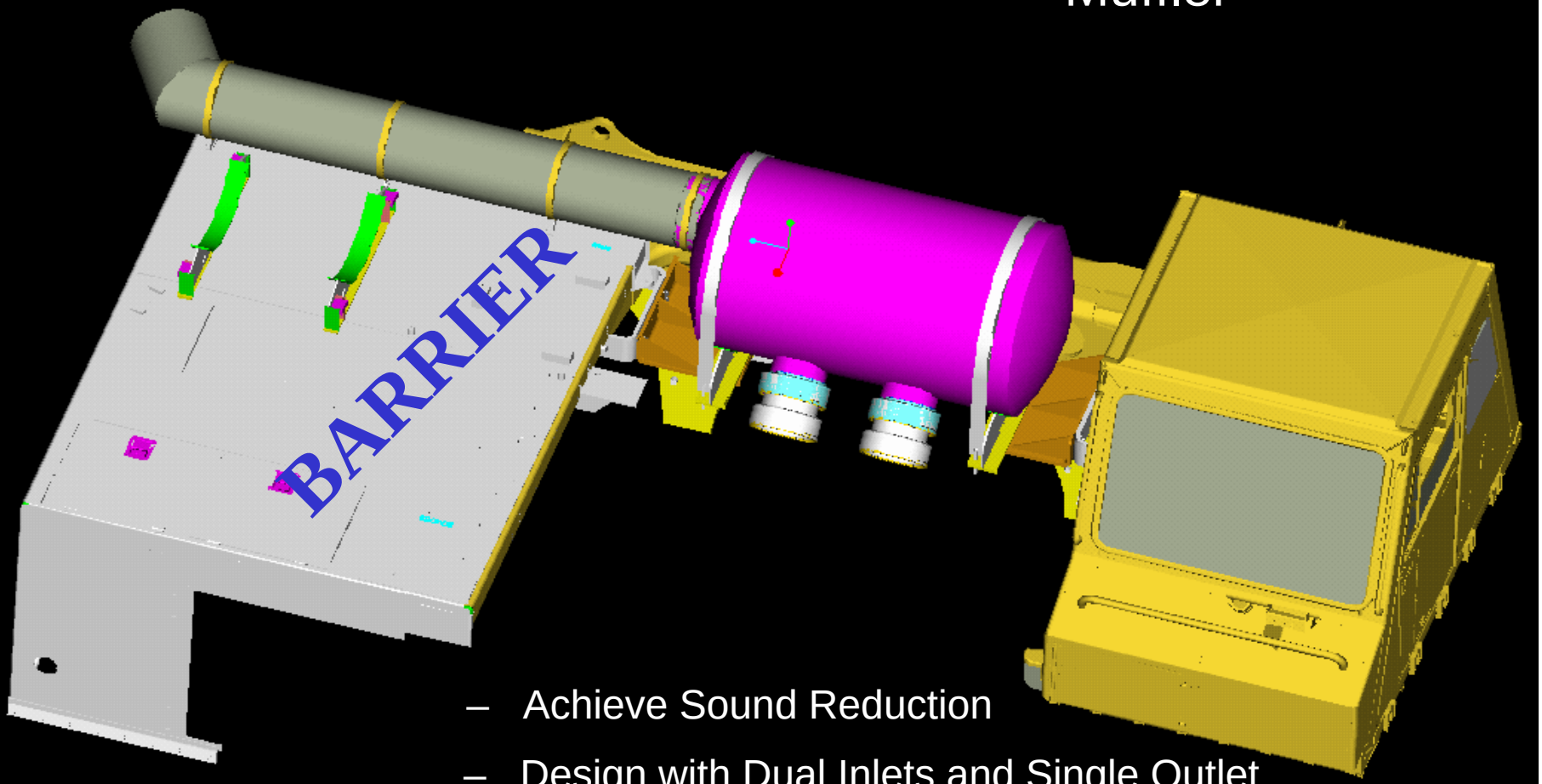
- Why do analysis?
  - Make predictions and determine testing procedure
  - Validate model with testing
  - Redesign with high confidence without cost and time of additional testing
- What types of analysis were done?
  - Finite Element Analysis (Static)
  - Flex-body Analysis (Dynamic)

793C XQ Approach

- Engine
- Fan
- Exhaust
- Transmission / Drivetrain
- Hydraulics

Design Goals/Criteria

- Muffler



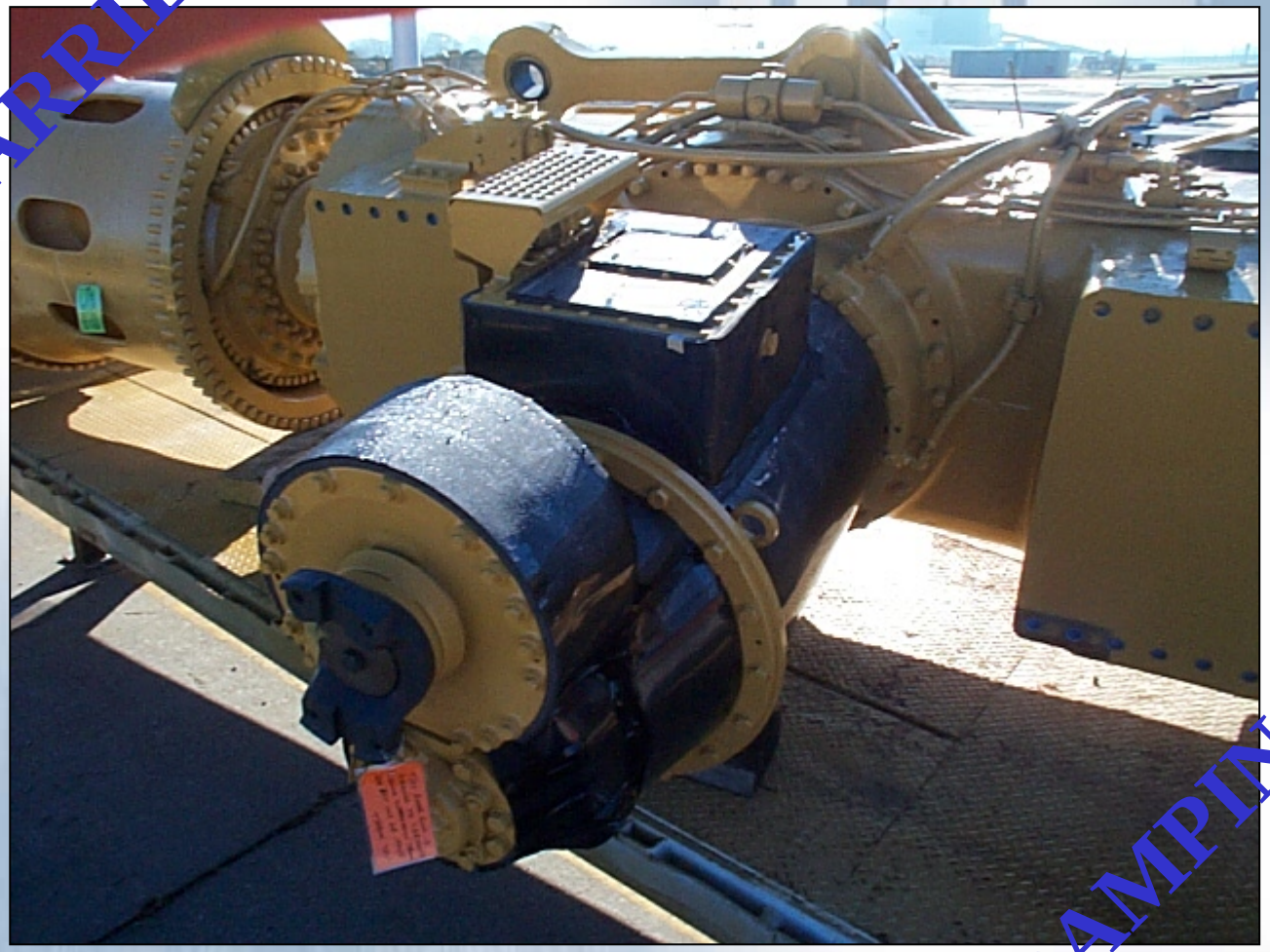
- Achieve Sound Reduction
- Design with Dual Inlets and Single Outlet
- Minimize Restriction

SIMPLFD REP: SLIDE3

793C XQ Approach

- Engine
- Fan
- Exhaust
- Transmission / Drivetrain
- Hydraulics

Transmission Wrap



Driveshaft Treatment

BARRIER

ABSORPTION

DAMPING

793C XQ Approach

- Engine
- Fan
- Exhaust
- Transmission / Drivetrain
- Hydraulics

Isolated Pump Drive

DAMPING

793C XQ in Australia

Combined effect of sound reduction treatments = 9 dB(A)

- **Per ISO6393**
- **1 truck now emits same level of sound as 8**

=

Per ISO6394

- **Operator sound reduction = 7 dB(A)**

FORWARD MINING

OPEN DISCUSSION QUESTIONS